Water Neighborhood*

Time

one to three 45-minute sessions

Vocabulary

aquatic, biomass, biotic index, dissolved oxygen, diversity, erosion, habitat, healthy, indicator species, meander, mussel, pH, pollutant, pollution, pool, population, riffle, temperature, turbidity, water quality, watershed

Objectives

Students will:

- identify several aquatic organisms.
- assess the relative environmental quality of a stream or pond using indicators of pH, water temperature, and the presence of a diversity of organisms.

Method

Students investigate a stream or pond using sampling techniques.

Materials

identification books (i.e., A Golden Guide to Pond Life)
Student Worksheets I and *II*
sampling equipment (seine nets, sieves, assorted containers, white trays, magnifying lenses, eye droppers, forceps, thermometer, meter sticks or tape measure, microscopes)
water quality test kit (with tests for pH and dissolved oxygen) (Note: A simple water quality test kit can be obtained from scientific supply houses dealing with high school biology supplies. Kits may be available from a high school biology teacher, county conservation board, certain state parks, wildlife agencies, or local universities.)

Background

The General Land Office (GLO) in 1812 sent surveyors to the "new frontier" to survey the land for disposal. The surveyors of Iowa noted vast prairies, troublesome wetlands, and rich forests as they made their way across the land. In some areas, they were the first Euro-Americans to record the vegetation and wildlife in what would become townships. In their notes, they described numerous beavers, muskrats, and minks living along bodies of water.

The South and North Skunk Rivers begin in central Iowa, join in southeastern Keokuk County, and flow to the Mississippi River. Surveyors' maps show that the Skunk River was a forested river, in contrast to the surrounding tallgrass prairie. Historically, its **watershed** (land that drains into a particular body of water) consisted of prairie and wetlands near its source and forests near its confluence with the Mississippi.

Since Euro-American settlement, the majority of the Skunk River's watershed has been changed for agriculture and urbanization. For example, in Story County, approximately 92% of the land is either cropland or urban, and in Jasper County it was straightened and the **meanders** (turns or winding of a

* Adapted from "A Lesson Plan for Some Water Investigations," Investigating Your Environment Series, U.S. Forest Service, Revised 1977.

stream) were cut through. In this county it is sometimes referred to as the "Skunk River Ditch." Some portions of the Skunk River Greenbelt (riparian area) are publicly owned and remain forested. Others are developed for farming or urban areas. In 2002, the Environmental Protection Agency declared a portion of the Skunk River impaired from pesticides. Pesticides affect **aquatic** (growing, living in, or frequenting water) life in the river.

In 1998, Dr. Jim Colbet, a professor at Iowa State University (ISU), began a community service activity entitled the "Skunk River Navy." ISU freshman biology students monitor water quality and **populations** (number of a particular species in a defined area at a given time) of native fresh water **mussels** (mollusks that have two shells and are collector-filterers), work to reduce **erosion** (removal or wearing away of soil or rock by water, wind, or other forces or processes), and improve the aesthetic quality of the Skunk River in Story County. This project allows students to learn about the biology of Iowa, while making a positive contribution to their community.

All organisms of an ecosystem are dependent upon each other. A large aquatic animal, such as a river otter, cannot survive if it has few fish, crayfish, and mussels to eat. Fish, crayfish, and mussels cannot survive without smaller fish, insects, and plankton to eat, and so on. In streams and ponds, the presence or absence of certain organisms, called **indicator species**, reveals much about **water quality** (condition of water). The absence or presence of organisms that are sensitive to **pollutants** (substances that may contaminate air, water, or soil) is an indicator of water quality.

The **biotic index** (number of kinds of living organisms found in an ecosystem) also is related to water quality. The presence of numerous aquatic species usually indicates a **healthy** (able to support life) environment. A water body with just a few different species usually means conditions are less healthy. **Pollution** (contamination of soil, water, or atmosphere by the discharge of harmful substances) generally reduces the quality of the environment and, in turn, the diversity of life forms. In some cases, the actual **biomass** (amount of living organisms) will increase because of pollution, but the **diversity** (variety) inevitably goes down.

For more information on the Skunk River Navy visit www.biology.iastate.edu/SRN/SRN.html. **For more information on the General Land Office (GLO) project, refer to *Iowa's Water*, page 5.**

Procedure

Before the Activity

1. Select a small, fairly shallow, slow-moving stream or pond near your school as the sampling site for this activity. Be sensitive to the impact you may have on stream banks and beds, spawning and nesting sites, and vegetation. Have students establish ethical guidelines for their sampling activities. If the stream is not a public site, obtain permission to visit it. Advise students in advance to dress for the setting – old (sturdy) shoes and shorts or jeans are best.
   NOTE: If a site visit is not possible, modify the activity to be conducted in the classroom.
2. Share the *background information* on the GLO project, conditions of Iowa after settlement, and settlement's impact on the Skunk River.
3. At the sampling site, brief students on habitat courtesies, working from their own list of ethical guidelines for sampling activities. Instruct them on how to minimize damaging the **habitat** (arrangement of food, water, shelter or cover, and space suitable to animals' needs) and encourage care in their collecting techniques. Emphasize that all wildlife is to be returned to its habitat unharmed. Decide whether you will take some of the organisms back to school for further study.
4. Begin the activity by observing the water. Identify organisms on the surface and in the depths. Use sampling equipment (nets, trays, sieves, etc.) to collect as many different forms of animal life as possible. Sample different microhabitats near rocks, in **riffles** (area of a stream with faster current; usually more shallow with the water surface broken up due to flowing over rocks) and in **pools**

(area of a stream which is deeper than adjacent areas, water flow is slower and the bottom is usually made of very small particles). Place animals in white trays for viewing and drawing so you can see the animals in detail. Keep adequate water in the trays and place them in a cool, shady spot. Change the water as often as needed to keep the animals cool. This is a good time to use the microscopes, if available.

5. On *Student Worksheet I*, have students identify and draw animals they observed (either in the water or in collection containers). Ask them to fill in the number of each kind found and to describe the location where the animal was found. Once these observations are completed, carefully return animals to their natural habitat.
   NOTE: If you choose to take some of the animals to the classroom, be sure you have adequate water as cool as in the natural setting. You may place organisms in Petri dishes or any shallow transparent dish and use an overhead projector to project images onto a screen or wall.
6. Encourage students to discuss their observations. How many kinds of organisms did they find? Explain that a variety of different kinds of plants and animals (diversity) usually indicates a healthy ecosystem.
7. Test the water at the field site for other indicators of quality. Using the water quality test kit, have students determine **dissolved oxygen** (molecules of oxygen gas dissolved in water) and **temperature** of the water as well as **pH** (a measure that indicates the relative acidity or alkalinity of a substance) and air temperature.
8. Note the color of the water. A cloudy, black/brown indicates sediment (**turbidity**); cloudy green indicates one-celled algae. Are other kinds of algae present? Are stream banks eroded? What is the cover of the riparian area (forested, grass, bare)? Is the stream straight or meandering? What is on the bottom of the stream – silt, sand, or rock? Is there anything else that might affect water quality (look for tile lines, trash, spilled oil, etc.)? These items can indicate soil erosion, channelization, removal of bank vegetation, nitrates, etc.
   NOTE: Students may also measure stream velocity, which can be accomplished by timing a floating object (i.e. a ping pong ball) as it travels a known distance (i.e. 10 feet).
9. Discuss how pH, water and air temperature, turbidity, and dissolved oxygen (DO) affect the diversity of life forms found in aquatic environments. Would you expect the same variety of life in other locations? Predictions of animal diversity can be made from measurements of dissolved oxygen, water temperature, turbidity, and pH. Likewise, certain indicator species also can disclose information about DO and water temperature. The latter measurements have the greatest impact in Iowa.
10. Ideally, you could repeat this activity at other sites with different characteristics. Biologists examine hundreds of sites in order to try to understand and predict what is happening in natural systems. If you visit another site, it might be useful to divide the class into two groups with one half doing *Student Worksheet I* and the other half doing *Student Worksheet II*. When each group is finished, students could come together and mutually predict what the other group found.
11. Re-emphasize the fact that diversity of animals is a useful indicator of habitat quality as well as an overall indicator of environmental quality.

Evaluation

1. Draw a simple illustration of one or more of the collected organisms. Identify each organism and write the correct name beside the picture.
2. How can water quality be determined?
3. Is water quality important? Why or why not?
4. Scenario: You found a trout in a stream with a large variety of other organisms. Predict ranges you would expect to find for DO and water temperature.

5. Based on the data you gathered, is this body of water healthy? Does it contain a diverse community of species?
6. Did you find any indicator species? If so what were they? What does this tell us about the stream?
7. How has Iowa changed since the surveyors surveyed Iowa? How has it stayed the same?
8. Do the actions of people living on the land affect water quality? Why or why not?

Extensions

Sample the stream above and below the local water supply.

Find the most diverse and least diverse streams in the area.

Monitor a local stream. Contact IOWATER, www.iowater.net/defaultExp.htm, for details on training. Adopt a local stream.

Research what your county was like before settlement. Go to www.public.iastate.edu/~fridolph/dnrglo.html for more information on the General Land Office project.

Teacher Aids

Posters

"Aquatic Life." Ill. Brian Wignall. 1989. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Benthic Macroinvertebrates." Ill. SB Lauterbach. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Fish Iowa! Fish Posters." Ill. Maynard Reese. 1994. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Life in a Stream." Ill. Brian Wignall. 1989. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

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"Biodiversity of Iowa: Aquatic Habitats." 2001. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Canaries of the Deep, The Plight of the Fresh Water Mussel." 2003. Geode Resource Conservation and Development Incorporated.

Books

Iowa Department of Natural Resources. 1987. Iowa Fish and Fishing. Des Moines.

Zim, H.C. and A.C. Martin. 1987. A Golden Guide to Pond Life. New York: Golden Press.

Dissolved Oxygen (DO) Requirements for Native Fish and Other Aquatic Life (DO in parts per million [ppm])

(Below 68 °F)	(Above 68 °F)
Cold-water organisms including trout	Warm-water organisms including fish such as bass, crappie, catfish, and carp

6 ppm ---------- 5 ppm

Temperature Ranges (Approximate) Required for Certain Organisms

Temperature	
Greater than 68 °F 920 °C) = Warm water	Much plant life, many fish diseases
	Most bass, crappie, bluegill, carp, catfish, caddisfly, dragonfly, mayfly, mussels
55 – 68 °F (12.8 – 20 °C) = Cool water	Plant life, some fish diseases
	Salmon, trout, stonefly, mayfly, caddisfly, water beetles, small-mouth and rock bass, various minnows and darters, mussels
Less than 55 F (12.8 °C) = Cold water	Trout, caddisfly, stonefly, mayfly, various minnows, darters, sculpins

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pH Ranges That Support Aquatic Life

Most Acidic ---------- Neutral ---------- Most Basic
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Bacteria
1.0 ---------- 13.0
Plants (algae, rooted, etc.) 6.5 ---------- 13.0
Carps, suckers, catfish, some insects
6.0 ---------- 8.5
Bass, crappie 6.0 ---------- 8.5
Snails, clams, mussels 6.5 ---------- 9.0
Largest variety of animals 6.0 ---------- 8.5
(trout, mayfly, stonefly, caddisfly)

Student Worksheet I

Where Organism Was Found	Sketch of Organism	Number Found

Student Worksheet II

	Observations	Predictions
Water Temperature		
Dissolved O_2		
Air Temperature		
pH		
Comments:		